COURSE SYLLABUS

1. Program information

1.1. Institution	Petroleum-Gas University of Ploiesti
1.2. Faculty	Petroleum Refining and Petrochemistry
1.3. Department	Petroleum Processing Engineering and Environmental Protection
1.4. Field of study	Chemical engineering
1.5. Study cycle	Master
1.6. Study program	Chemical Engineering for Refineries and Petrochemistry

2. Course information

2.1. Course title	Thermal integration, energy efficiency and utility systems		
2.2. Course coordinator	Negoiţă Loredana Irena		
2.3. Seminar coordinator	Negoiţă Loredana Irena		
2.4. Project coordinator	Negoiţă Loredana Irena		
2.5. Year of study	1		
2.6. Semester *	II		
2.7. Evaluation type	written exam + oral project support		
2.8. Course type - formative category **	D1	2.8. Type of subject matter ***	C

* the semester number is in accordance with the curriculum;

** fundamental = F0; domain = D1; speciality = S2; complementary = C3

*** compulsory = C; optional = O; elective = E

3. Total estimated time (teaching hours per semester)

3.1. Number of hours per week	4	of which: 3.2. course	2	3.3. Seminars/laboratories	1	3.4. Project	1
3.5. Total hours from curriculum	56	of which: 3.5. course	28	3.6. Seminars/laboratories	14	3.7. Project	14

3.8. Time distribution	hours
Study of textbook, course support, bibliography and notes	25
Further reading in the library, on online platforms and fieldwork	22
Preparing seminars / laboratories, homework, portfolios and essays	20
Tutoring	-
Examinations	2
Other activities	0

3.7. Total hours of individual study	69
3.8. Total hours per semester	125
3.9. Number of credits	5

4. Prerequisites (where applicable)

4.1. of curriculum	Heat transfer processes, Thermoenergetics
4.2. of skills	

5. Requirements (where applicable)

5.1. of course	The classroom with blackboard, screen, video projector
5.2. of seminars/project	The room with blackboard, screen, video projector, computers

6. Specific competences

Professional competences	Defines the process and designs technical components: the description, analysis and advanced use of fundamental concepts and theories in the field of chemical engineering. Designs equipment and apparatus for utilities: the design of apparatus, processes and installations with the application of knowledge in the field of chemical engineering.
Cross-cur competences	The ability to provide permanent information and documentation in his/her field of activity, but also in related fields, both in Romanian and in an internationally spoken language. Efficient and effective performance of individual professional activities, in conditions of autonomy and professional independence. The ability to carry out professional tasks as a team leader.

7. Course objectives (based on the competence grid)

7.1. General objective	The main objective of the course is to deepen and develop knowledge in the fields of heat transfer and thermoenergetics in order to facilitate the finding of energy efficient solutions in certain technological processes.
7.2. Specific objectives	At the end of the course, students will be able to: - identify the practical situations in which heat transfer mechanisms occur; - illustrate the role of utility systems in technological processes; - define and list the composition and characteristics of heat supply systems and utilities; - find solutions to increase energy efficiency.

8. Contents

8.1. Course	Time	Teaching methods	Comments
1. Heat Transfer Mechanisms	2		
2. Partial and overall heat transfer coefficients	2		
3. Heat exchangers. Thermal and hydraulic calculation	2		
4. Performance indicators of heat exchangers. Increase the efficiency of heat exchangers	2		
5. Combustion processes. Tubular furnaces. Real and optimized heat balance	2	Interactive exposition, problem-solving,	

6. Thermal energy regenerative systems	2	heuristic conversation, exemplification.	
7. Thermal energy recovery systems	2		
8. Cooling water systems used in refinery	2		
9. Production and use systems of steam in refinery	2		
10. Thermoenergetics systems with cogeneration	3		
11. Thermal integration of heat exchanger networks using the Pinch method	3		
12. Fuel supply systems	2		
13. Inert gas supply systems	2		

Bibliography

1. Incropera, F., Dewitt, D. P., Fundamentals of heat and mass transfer, Seventh edition, John Wiley and Sons, U.S.A., 2011.
2. Popescu, N., Dinu, R. C., Energetica instalaţiilor de producere a energiei în cogenerare, Editura Universitară, Craiova, 2013.
3. Allan, P. R., Improve Energy Efficiency via Heat Integration, American Institute on Chemical Engineering, December, 2010.
4. Cao, E., Heat transfer in process engineering, The McGraw-Hill Companies, USA, 2010.
5. Green, D.W, Perry R. H., Perry's Chemical Engineers' HandBook, 8nd ed., McGrawHill, USA, 2008.
6. Lienhard, J. H. IV, Lienhard J.H.V, A heat transfer Textbook, 4th ed., Phlogiston Press, Cambridge, Massachusetts, U.S.A., 2011.
7. Rokni, M., Introduction to Pinch Technology, Kgs. Lyngby: Technical University of Denmark, 2016, http://orbit.dtu.dk/files/123620478/Pinch_Tech_1.pdf.
8. Jiří, J. K., Zdravko, K., Forty years of Heat Integration: Pinch Analysis (PA) and Mathematical Programming (MP), Current Opinion in Chemical Engineering, Vol. 2, No. 4, 2013.

8.2. Seminar	Time	Teaching methods	Comments
Logarithmic mean temperature difference for flows in a heat exchanger. Heat exchangers - with and without phase transformation - applications	6	Seminars are conducted interactively, discussing the results	
Combustion calculations and thermal balances on furnaces - applications	2		
Thermal power plants - applications	2		
Optimizing a heat exchanger network by applying the PINCH method - example of calculation	4		

Bibliography

1. Green, D.W, Perry R. H., Perry's Chemical Engineers' HandBook, 8nd ed., McGrawHill, USA, 2008.
2. Allan, P. R., Improve Energy Efficiency via Heat Integration, American Institute on Chemical Engineering, December, 2010.
3. Lienhard, J. H. IV, Lienhard J.H.V, A heat transfer Textbook, 4th ed., Phlogiston Press, Cambridge, Massachusetts, U.S.A., 2011.
4. Rokni, M., Introduction to Pinch Technology, Kgs. Lyngby: Technical University of Denmark, 2016, http://orbit.dtu.dk/files/123620478/Pinch_Tech_1.pdf.

8.2. Project	Time	Teaching methods	Comments
Presentation of a technological unit	1	Interactive exposition,	

Establishing initial design data, example application	2	problem-solving, discussing the results	
Presentation of the thermal balance for a heat exchanger	2		
Calculation of heat transfer coefficients for the heat exchanger; Setting the calculation algorithm in the Excel program. Simulation of results with PROII software.	6		
Interpretation of the results obtained	1		
Project evaluation	2		

Bibliography

1. Dobrinescu, D., Procese de transfer termic şi utilaje specifice, EDP, Bucureşti, 1983.
2. Pătraşcu, C., Termoenergetica prelucrării petrolului, Editura UPG, Ploieşti, 2003.
3. Popa , B., Manualul inginerului termotehnician,Ed.Tehnică, Bucureşti,1986.
4. Ludwig, E., Applied Process Design for chemical and Petrochemical Plants, Golf Publishing Company, Texas,1987.
5. Incropera, F., Fundamentals of Heat and Mass Transfer, John Wiley & Sons, New York, 2002.
6. Leca, A., Transfer de căldură şi masă, Ed. Tehnică, Bucureşti, 1998.

9. Correlation of the course contents with the demands of the epistemic community representatives, professional associations and representative employers in the field of the program

The content of the course, seminar and project correspond to the curriculum from other university centres, from the country or from abroad. In order to better adapt to the requirements of the labor market the content of the course, meetings were held, both with representatives of economic partners, with graduates, as well as with teachers from the faculties that specialize in chemical engineering.

10. Evaluation

Activity	10.1. Evaluation criteria	10.2. Evaluation methods	10.3. Percentage of final grade
10.4. Course/Seminar	Theoretical knowledge evaluated by questions related to the subjects presented in the course	Written exam	40 %
	Applied knowledge evaluated by solving problems / numerical applications similar to those presented at the seminar		30%
10.5. Project	Theoretical knowledge evaluated by questions related to the subjects presented in the project; Rhythmicity for each stage of the project.	Oral project support	30 %

Evaluation conditions	The weighting in the final note applies if, by both assessment methods, notes are at least 5.

10.6. Minimum performance standard

Written examination:
- ➢ For 5, it is necessary to obtain a minimum score of 50% for theoretical knowledge, as well as to prove a minimum level of understanding and solving the applications in the exam subject (minimum 50%).
- ➢ For 10 it is necessary to obtain a maximum score for theoretical knowledge and complete and correct solving of the applications in the exam subject (minimum 95%).

10. Evaluation

Activity	10.1. Evaluation criteria	10.2. Evaluation methods	10.3. Percentage of final grade
10.4. Course	Theoretical knowledge evaluated by questions related to the subjects presented in the course	Written exam	40 %
10.5. Seminar / laboratory	Applied knowledge evaluated by solving problems / numerical applications similar to those presented at the seminar	Written exam	30%
10.6. Project	Theoretical knowledge evaluated by questions related to the subjects presented in the project; Rhythmicity for each stage of the project.	Oral project support	30 %

10.7. Minimum performance standard

Written examination:
- ➢ For 5, it is necessary to obtain a minimum score of 50% for theoretical knowledge, as well as to prove a minimum level of understanding and solving the applications in the exam subject (minimum 50%).

   For 10 it is necessary to obtain a maximum score for theoretical knowledge and complete and correct solving of the applications in the exam subject (minimum 95%).

Signature date 05.02.2025	Course coordinator	Seminar/laboratory coordinator	Project coordinator

Date of approval in the department	Head of department Associate Prof. PhD. eng. Mihaela Neagu	Dean Assistant Prof. PhD. eng. Cristina Dușescu-Vasile

___20.03.2025_____